

BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 3

SEPTEMBER 1956

PART 13

INSTITUTE NEWS

Institute's New Headquarters

Fourth List of Donations

The Council gratefully acknowledges the following additional donations to the funds of the Institute, towards the purchase of the lease of 17 Belgrave Square, S.W.1, as a new Headquarters of the Institute and of its equipment.

	£	s.	d.
*Birmid Industries, Ltd.	10	50	0
Rhokana Corporation, Ltd., Nchanga Consolidated Copper Mines, Ltd., and The Rhodesia Broken Hill Development Co., Ltd.	500	0	0
*Murex, Ltd.	350	0	0
Aluminium Union, Ltd.	250	0	0
Mufulira Copper Mines, Ltd.	250	0	0
Roan Antelope Copper Mines, Ltd.	250	0	0
Stone (J.) and Co. (Charlton), Ltd.	250	0	0
English Electric Co., Ltd., The	100	0	0
Kroll, Dr. W. J. (U.S.A.)	100	0	0
McKechnie Brothers, Ltd.	100	0	0
Batchelor, Robinson and Co., Ltd.	52	10	0
Braby (Fredk.) and Co., Ltd.	50	0	0
Gardner (Henry) and Co., Ltd.	50	0	0
Holroyd (John) and Co., Ltd.	50	0	0
London Electric Wire Company and Smiths, Ltd.	50	0	0
Non-Electrical Copper Association	50	0	0
Rollet (H.) and Co., Ltd.	26	5	0
Chalmers (E.) and Co., Ltd.	21	0	0
Star Aluminium Co., Ltd.	20	0	0
Foundry Services, Ltd.	15	0	0
Arkinstall Brothers, Ltd.	10	10	0
Liddiard, Mr. E. A. G.	10	10	0
Robson, Mr. E.	10	10	0
Cottrell, Dr. A. H.	5	5	0
Geach, Dr. G. A.	5	5	0
Marshall, Mr. W. K. B.	5	5	0
Tector, Mr. F. J.	5	5	0
Brereton, Mr. C. F.	5	0	0
Spettle, Mr. A.	5	0	0
Callis, Mr. G. T.	3	3	0
King, Mr. F.	2	2	0
McKechnie, Mr. A. R.	2	2	0
Bucknell, Mr. G. L.	2	0	0
Hooper, Mr. W. H. L.	1	1	0

* Donations under covenant. The amount stated is the total to be received, including the tax recoverable at the present standard rate.

Turner, Dr. A. N.	1	1	0
Yates, Major L. J.	1	1	0
Nedorostek, Director L. J. (Germany)	1	0	0

"Metallurgical Reviews"

The first issue of the Institute's new quarterly, *Metallurgical Reviews*, has now been published and the second issue is expected to appear by the end of September. It is regretted that publication of the first two issues has been seriously delayed, but it is still hoped that the fourth issue will be available by the end of the year, and thereafter *Metallurgical Reviews* is expected to appear at regular quarterly intervals.

All members should have received details of *Metallurgical Reviews*. Briefly, its purpose is to present authoritative, critical, and interpretative reviews of knowledge in various fields of interest to metallurgists. The reviews are being written for the non-specialist, and will cover the whole field of metallurgy except mining, the extraction of metals from their ores, and iron and steel works practice. It is intended that the contents shall be equally distributed as between industrial and theoretical topics.

Experience in other fields of applied science has satisfied the Council that there is a real demand for a periodical of this character, and it is hoped that it will receive wide support. *Metallurgical Reviews* is intended to be self-supporting; any credit balance will be devoted to its expansion.

Details of the contents of the first two issues and rates of subscription will be found in the announcement on p. 117.

PERSONAL NOTES

DR. K. W. ANDREWS has been awarded the degree of D.Sc. of Manchester University.

MR. P. J. BOWLES has left the Royal School of Mines and taken up a post in the A.E.I. Research Laboratory, Aldermaston, Berks.

MR. R. BULLOUGH has been awarded the Ph.D. degree of Sheffield University. He is now at the A.E.I. Research Laboratory, Aldermaston, Berks.

MR. G. N. CALE has left the British Leather Manufacturers' Research Association to take up the post of Chief Research Officer to the Heating and Ventilating Research Council.

MR. A. J. DAVIS has taken a post as metallurgist on the staff of the Research Laboratories of The General Electric Co., Ltd., Wembley.

MR. R. C. FARMER has been appointed Assistant Chief Metallurgist to Linread, Ltd., Birmingham.

PERSONALITIES

DR. G. B. GREENOUGH, Senior Lecturer in Physical Metallurgy at the University of Sheffield, has been appointed Research Manager, Atomic Energy Authority (Industrial Group), Windscale, Cumberland.

MR. H. W. G. HIGNETT has been appointed Assistant Managing Director of Henry Wiggin and Co., Ltd. Mr. Hignett was previously director of the Company responsible for technical (metallurgical) control and development in all Wiggin plants.

MR. H. C. HULME has been appointed Works Manager to The Delta Metal Co., Ltd., Birmingham.

MR. KEHSIN KUO has left Sweden and gone to the Institute of Metal Research, Academia Sinica, Shenyang (Mukden), China.

MR. T. B. SMITH has been awarded the Ph.D. degree of the University of Birmingham and has taken up an appointment as a research metallurgist with The British Thomson-Houston Co., Ltd., Rugby.

MR. J. W. SUITER has been awarded the Ph.D. degree of Melbourne University. He is now working in the Refractory Metals Section, Mines Branch, Dept. of Mines and Technical Surveys, Ottawa, having received a fellowship from the National Research Council of Canada.

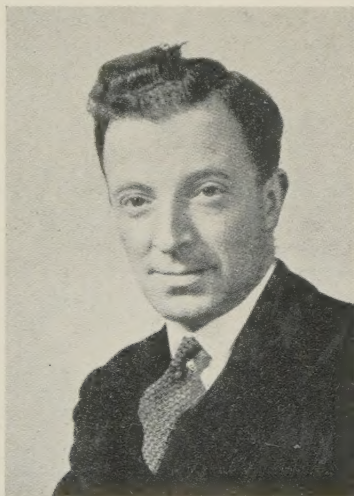
MR. F. WILD has obtained the B.Met. degree of Sheffield University and has taken up an appointment with A. V. Roe and Co., Ltd.

PERSONALITIES

Mr. H. W. G. Hignett

(Chairman, Birmingham Local Section)

Born in 1905, H. W. G. Hignett was educated at Bury Grammar School and decided on a chemical career. However, he became an engineer by *force majeure* and a metallurgist by accident, in due course obtaining an external degree at London University.



After seven years as a metallurgist with Messrs. C. Walmsley and Co., Ltd., of Bury, Lancashire, he joined the Aluminium Plant and Vessel Co., Ltd., London, in 1930, and became an acknowledged authority on welding processes. At the end of ten happy years with this Company, under Dr. Richard Seligman, he joined the Development Section of the Develop-

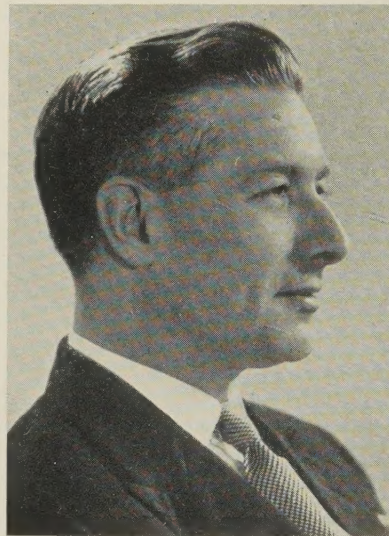
ment and Research Department of The Mond Nickel Co., Ltd., transferring in August 1945 from the Development to the Research section to become Superintendent of the Research Laboratory in Birmingham. In this position he lasted nine years before being found out and moved to Production—as Technical Director of Henry Wiggin and Co., Ltd. Last July he was made Assistant Managing Director of the Company.

Mr. Hignett was elected a member of the Institute in 1930 and served on the Council from 1942 to 1946 and again from 1949 to 1952. He is a Fellow of the Royal Institute of Chemistry, Fellow of the Institution of Metallurgists, Member of the Institute of Welding, and of the Iron and Steel Institute, the American Society for Metals and the A.I.M.E. A Past-President of the Birmingham Metallurgical Society, he now appreciates with some relief that his year of office is forgiven if not forgotten.

Dr. Edwin Rhodes

(Chairman, London Local Section)

Born in 1907 “almost within the sound of Bow Bells”, Edwin Rhodes graduated at London University, first in General Science Honours and later took Honours in Chemistry.



He subsequently carried out investigations in electrochemistry and was associated with the publication of many papers concerned with the conductivity of electrolytes. In 1934 he was awarded the degree of Ph.D.

In the early 1930s, he entered the ranks of those chemists who have found their scientific interests leaning more and more to metallurgy, and he thinks that the metamorphosis has now been complete for many years.

He joined The Mond Nickel Co., Ltd., in the late 1920s and became active in metallurgical investigations with special reference to precious metals in the early 1930s. For many years, until mid-1955, Dr. Rhodes was Superintendent of the Precious Metals Division of the Development and Research Department of The Mond Nickel Company. He is at present Assistant to the Manager of that Department.

He is a Fellow of the Royal Institute of Chemistry and a Fellow of the Institution of Metallurgists. He was elected a Member of the Institute in 1940 and from 1946 until 1954 was Honorary Secretary of the London Local Section.

REFRATORIES FOR USE IN THE NON-FERROUS METALS B15 INDUSTRY

An Informal Discussion on "Refractories for Use in the Non-Ferrous Metals Industry" was held at Birmingham University on 24 February 1956, under the auspices of the Metallurgical Engineering Committee. Its object was to provide the opportunity for a frank exchange of views between furnace designers, makers and users of refractories, and research workers.

The chair was taken by Dr. N. P. Inglis, Ph.D., M.Eng., M.I.Mech.E., F.I.M. (Vice-President).

A short account of some of the main points of the discussion is given below.

THE discussion was initiated by short contributions by Mr. R. Chadwick (Imperial Chemical Industries, Ltd., Metals Division) and Mr. W. H. Horsman (The British Aluminium Co., Ltd.).

Mr. Chadwick dealt with the three main types of furnace used in melting copper and brasses. He pointed out that modern economic conditions made furnace failures very costly, as loss of output of expensive metals such as copper soon involved the loss of hundreds of thousands of pounds. Modern requirements in fuel economy put strains on the ability of refractories to withstand the higher and more uniform temperatures induced by insulation. Hence, in reverberatory furnaces, magnesia was used for the walls, spalling-resistant chrome-magnesia for the roof, and silica for the bottoms. In arc furnaces, whose use for the melting of phosphorus-deoxidized copper was relatively new to this country, slagging effects upon the refractories were much more severe than with the reverberatory furnace.

Thirdly, the Ajax-Wyatt low-frequency furnace was dealt with, the well-known requirements for the V-notch of such furnaces—low porosity, careful tamping, graded structure—were detailed, together with a description of typical failures, but not much help could be derived to assist in the efficient running of these furnaces. It was stated that aluminosilicates were suitable for brass melting, whereas copper and cupronickel required high-silica or high-alumina refractories, with a strong preference for silica.

Mr. Horsman, dealing with furnaces for aluminium and its alloys, said that the chief difficulty with aluminium was the ready formation of the oxide and the great chemical reactivity of the oxide in forming compounds with silica and magnesia. The melting point of aluminium was low, so that until recently the conditions imposed on furnaces had not been severe; however, the use of oil fuel and greatly increased outputs for a given size of furnace had combined to increase the wear on furnaces and to create new problems in the choice of refractory materials.

The discussion which followed was divided into three parts; the general use of refractories and their specific use in connection with aluminium and copper and their alloys.

It was pointed out in regard to the general use of refractory materials that metals did not wet these materials. Hence, if conditions were so arranged that no oxide existed in the molten metal, little or no reaction could take place with the refractory. That point was of great importance to the user of the low-frequency induction furnace.

There was not sufficient information available on the properties of metals and refractories at high temperature to enable a

good technical choice to be made of refractories for special purposes. Data were needed on the interfacial tension between metals and refractories, especially for metals containing oxides. The viscosity/temperature curves of metals were also very useful. With such information it should be possible to decide on the best refractory material chemically and to use it under the best physical conditions.

On the manufacturing side, there was a tendency, owing to high fuel costs, to shorten essential processes in the firing of refractories, the most important feature being curtailment of the annealing period. Most refractory materials had a glass bond when fired, and the purpose of annealing at a temperature just below the solidus was to ensure that this glass was converted into stable crystals. The resistance of correctly fired and annealed refractories to spalling, chemical attack, and so on, was very high compared with that of a rush-fired glass containing unstable material, no matter how high the temperature of firing.

The phase relations of many oxides had been studied, but the phase diagrams of non-oxide refractories, such as the phosphates and sulphides, had not been fully worked out. There were many possibilities for new refractories. It was considered desirable to conduct further fundamental research into the methods of determining specific heats and thermal conductivities at high temperatures, for it was more useful to know what some of these physical properties were at 1000° or 2000° C. than to know the average value between 20° and 1200° C.

In the case of furnaces for aluminium, in which the temperature range was quite moderate, a good, well-made firebrick refractory seemed to be satisfactory. The chief causes of wear were the reaction of aluminium with silica to give silicon, and the recent increase in temperatures following the introduction of oil fuel. Zircon had been tried, but its ready reaction with the fluxes used with aluminium tended to rule it out.

Good jointing was as important as good refractories, and the view was expressed that methods of making joints in brickwork would repay study. Some advantage had been obtained by glazing or coating the brickwork of aluminium furnaces with a mixture of sodium chloride and cryolite. In general there were no major problems in connection with the use of reverberatory furnaces for aluminium, but careful study of the use of the refractories could result in great economy.

Copper alloys presented a very different picture, and a wide variety of materials and methods were being tried both in reverberatory furnaces and in low-frequency furnaces of the Ajax-Wyatt type. It seemed quite clear that in reverberatory furnaces the best results were obtained with a composite lining,

LETTER TO THE EDITOR

hearth, side walls, roof, and gas- or oil-ports each being made of a refractory material suitable to its peculiar conditions of service. Water-cooling increased the life of some parts of such furnaces. With the low-frequency furnace, emphasis was laid on the careful grading of the tamping material, so as to produce an impervious layer next to the metal with increasing insulation properties and flexibility farther away from the metal. A series of photomicrographs were shown to illustrate the chemical reactions taking place in the notch of a low-frequency furnace, and these did much to confirm the opinion that the oxides of the metals were the main cause of chemical reaction. Notch design still required study, such matters as the prevention of static conditions, gas pockets, and the reversal of flow being very important.

On the practical side, it appeared that a more vigorous practical interest in the non-ferrous metals industry by the makers of refractories, with more co-operation between maker and user, was required. It also emerged that the actual cost of a refractory was no indication of the economics of its use.

A plea was made by a manufacturer of refractories for access to the technical staff of works, rather than to the executive or commercial staff, when a visit was made to sell refractories; this was countered by a plea that technical staff, rather than commercial salesmen, ought to be employed in selling and servicing refractories.

LETTER TO THE EDITOR

Superlattice Formation in Alpha Titanium-Aluminium Solid Solutions

The published phase diagrams of the titanium-aluminium system^{1,2} show an α phase field extending up to 24 wt.-% aluminium at 600°C., but there is indirect evidence from mechanical properties that the diagram is incomplete. Thus, an alloy containing 10% aluminium, which is ductile when quenched from high in the α field, becomes brittle when aged at 450–600°C., and there is a simultaneous decrease in the electrical resistance, too large to be readily accounted for by the precipitation of an impurity.³ More recently, Rausch, Crossley, and Kessler⁴ have quoted hardness results for titanium-aluminium-vanadium alloys which show a pronounced minimum at 16% aluminium, irrespective of vanadium content. No published X-ray or metallographic data have provided a satisfactory explanation of this behaviour.

We have undertaken a re-determination of the lattice parameters of high-purity titanium-aluminium alloys containing up to 20 wt.-% aluminium, water-quenched after annealing at several different temperatures, in an attempt to obtain evidence of phase changes or of a change in type of bonding. In the course of this work, superlattice reflections have been observed that indicate the existence of an ordered phase Ti_3Al . This is analogous to the ordered γ phase, Ti_3Sn in the titanium-tin system⁵ and agrees well with the recent observations of McQuillan.⁶ Lattice-parameter/composition curves have so far been obtained at two ageing temperatures, 850° and 650°C., and the a parameter in each case shows an abrupt discontinuity between the ordered and disordered alloys. X-ray photographs of alloys immediately preceding the ordered region show a characteristic and very marked broadening of the reflection. Thus, whilst the 12% aluminium alloy shows this broadening at both 850° and 650°C., the 10% alloy shows it only at 650°C. This effect is being investigated further.

A full account of the work, including micrographs and hardness data, will be published later.

D. CLARK
J. C. TERRY

Royal Aircraft Establishment,
South Farnborough,
Hants.

REFERENCES

1. H. R. Ogden, D. J. Maykuth, W. L. Finlay, and R. I. Jaffee, *Trans. Amer. Inst. Min. Met. Eng.*, 1951, **191**, 1150.
2. E. S. Bumps, H. D. Kessler, and M. Hansen, *ibid.*, 1952, **194**, 609.
3. K. S. Jepson, G. O. Lewis, and D. Clark, unpublished work.
4. J. J. Rausch, F. A. Crossley, and H. D. Kessler, *Trans. Amer. Inst. Min. Met. Eng.*, 1956, **206**, 211.
5. P. Pietrokowsky, *ibid.*, 1952, **194**, 211.
6. M. K. McQuillan, *J. Inst. Metals*, 1955–56, **84**, 307.

NEWS OF KINDRED SOCIETIES

Australian Institute of Metals

At the Annual Conference of the Australian Institute of Metals held in May 1956 the following officers were elected:

President: Dr. HOWARD K. WÖRNER (2nd term of office).

Vice-Presidents: Mr. A. ASHTON and Mr. A. F. DUNBAR.

Hon. Federal Secretary: Mr. J. G. RITCHIE.

Hon. Federal Treasurer: Mr. E. D. CONNOR.

OTHER NEWS

Fourteenth Annual Pittsburgh Diffraction Conference

The Fourteenth Annual Pittsburgh Diffraction Conference will be held on 31 October, 1 and 2 November 1956, at the Mellon Institute, Pittsburgh, Pa.

Ample time will be given for the presentation and discussion of papers. It is the desire of the Conference Committee to emphasize this year the following subjects: (1) small-angle scattering, (2) high- and low-temperature diffraction studies, (3) structural aspects of solid-state physics, (4) instrumentation and methods, and (5) neutron diffraction.

Papers on the above subjects will be particularly welcome. Titles of contributed papers should be sent to the Programme Chairman, Dr. A. Taylor, Westinghouse Research Laboratories, Beulah Road, Pittsburgh 35, Pa.

University of Nottingham

Messrs. W. Canning and Co., Ltd., of Birmingham have established a research scholarship of the value of £600 per annum to be held in the Department of Metallurgy in the University. The scholarship will be awarded for research in the field of metal finishing.

The Electro-Chemical Engineering Co., Ltd., of Woking, Surrey have agreed to give £300 a year for three years to the Department of Metallurgy, towards the cost of a scholarship for research in metal finishing.

APPOINTMENTS VACANT

ALUMINIUM EXTRUSION PLANT. Owing to reorganization of Staff, a Works Manager is required. Current experience in a similar capacity essential. Rent-free house available. First-class superannuation scheme. Remuneration commensurate with experience. Extension schemes in hand provide every opportunity for advancement. Applications in complete confidence to Box No. 413, The Institute of Metals, 17 Belgrave Square, London, S.W.1.

Metallurgical Reviews

Published Quarterly by the Institute of Metals

CONTENTS

PART 1. (*now published*)

1. **Metallurgical Aspects of Microradiography.** By Professor J. J. Trillat, Doct. ès Sc. (*Professeur à la Sorbonne; Directeur du Laboratoire de Rayons-X du Centre National de la Recherche Scientifique, Bellevue (S. et O.), France*).
2. **Mechanical Properties in Relation to Design Requirements.** By Professor C. Richard Soderberg, S.B., Tekn.D. (*Dean of Engineering, Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.*).
3. **The Preparation and Properties of High-Purity Iron.** By B. E. Hopkins, M.Sc. (*Metallurgy Division, National Physical Laboratory, Teddington, Middlesex*).
4. **The Principles of Continuous Casting of Metals.** By D. M. Lewis, M.Sc., F.I.M. (*Head of Casting Section, Aluminium Laboratories Limited, Banbury, Oxon.*), and J. Savage, B.Sc., F.Inst.P. (*Head of Physics Department, British Iron and Steel Research Association, London, S.W.11*).

PART 2. (*ready shortly*)

5. **Electrolytic and Chemical Polishing.** By Dr. P. A. Jacquet (*Docteur de l'Université de Paris; Ingénieur Contractuel des Constructions et Armes Navales; Collaborateur Scientifique à l'Office National d'Etudes et de Recherches Aéronautiques (ONERA); Ingénieur-Conseil au Commissariat à l'Energie Atomique*).
6. **The Continuous Measurement and Control of Gauge in Strip Rolling.** By G. W. Alderton, B.Sc., A.R.C.S. (*U.K. Atomic Energy Authority, Capenhurst, Cheshire*), and W. C. F. Hessenberg, M.A., F.I.M. (*Deputy Director, British Iron and Steel Research Association, London*).
7. **Recent Developments in Temperature Measurement and Control.** By T. Land, M.A., F.Inst.P. (*Managing Director, Land Pyrometers, Ltd., Sheffield*).

Metallurgical Reviews is obtainable by annual subscription only; single copies are not sold. The annual subscription rates for 1956 are:

- (a) Members of the Institute of Metals (one subscription each)
32s. 6d. or \$5, post free.
- (b) Non-members, 42s. 6d. or \$6.50, post free.
- (c) Libraries, 35s. 5d. or \$5.40, post free.

THE INSTITUTE OF METALS, 17 BELGRAVE SQUARE, LONDON, S.W.1.

APPOINTMENTS VACANT AND REQUIRED

ANGLO AMERICAN CORPORATION OF SOUTH AFRICA, LTD.

(Incorporated in the Union of South Africa)

METALLURGICAL CHEMIST

An associate company of the Corporation wishes to engage a Metallurgical Chemist to work in South Africa on research problems in connection with TUNGSTEN CARBIDES.

Possession of a degree in Metallurgy or Chemistry and previous experience in powder metallurgy applied to tungsten carbide essential. Salary will be in accordance with qualifications and experience.

Successful applicant would be required to join pension fund and medical benefit society.

Initial contract would be for three years.

Travelling expenses to South Africa of applicant and wife and family would be borne by Company.

Applications giving full details of education and of positions held since graduating should be addressed to: Anglo American Corporation of South Africa, Ltd., 40 Holborn Viaduct, London, E.C.1.

BRITISH ALUMINIUM COMPANY has vacancy for Technical Abstractor/Translator (German, French) at Head Office. Science or Engineering background essential, industrial experience an advantage. Write to The British Aluminium Co., Ltd., Norfolk House, St. James's Square, London, S.W.1.

G.K.N. GROUP RESEARCH LABORATORY invites applications from METALLURGISTS, PHYSICISTS, or PHYSICAL CHEMISTS to work on the problems detailed below.

1. The galling and surface binding of titanium and its alloys.
2. The development of vacuum-casting techniques and the investigation of the effect of vacuum casting on the properties of high-temperature and other special-purpose alloys.
3. The creep testing of commercial forgings, or experimental cast alloys, and the development of design curves for the latter.
4. The improvement of industrial processes, with particular reference to the surface finish of the deposit.
5. The constitution and heat-treatment of silicon-iron alloys.
6. The study of recrystallization and grain growth and their effect in orientation development in silicon-iron alloys.

The Laboratory is the Central Research Establishment for a large Group of Companies engaged in a wide range of metallurgical and engineering activities. It is housed in modern buildings well equipped for both fundamental and development research. There is every opportunity for contact between the Laboratory and production units. The activities of the Laboratory are expanding and future prospects are excellent.

Applicants should possess a first- or second-class degree in the appropriate subject and preferably have had at least two years' research or industrial experience, although this need not be in the stated field.

Applications should be made to the Director of Research, G.K.N. Group Research Laboratory, Birmingham New Road, Lanesfield, Wolverhampton.

JUNIOR EXECUTIVE with engineering or metallurgical degree, required to understudy Managing Director in non-ferrous Centrifugal Foundry in the Midlands. Opportunity for young man with sales and foundry experience to obtain position of trust and confidence, with chance of becoming head of a lucrative business. Commencing salary £1000 per annum. Applicants will be interviewed in London or Birmingham. Box No. 414, The Institute of Metals, 17 Belgrave Square, London, S.W.1.

METAL RESEARCH

Physical Metallurgists and Physicists are required by The Mond Nickel Co., Ltd., at their Birmingham Laboratories, to join teams engaged on a wide variety of long- and short-term research projects bearing on the production and uses of nickel-containing materials. Whilst good academic qualifications are of importance, evidence of a candidate's ability to work on his own initiative is also essential. Sympathetic consideration is given to publication by scientific staff of original work of suitable standard. The Company offers attractive welfare facilities and pension scheme; in appropriate cases assistance can be given for housing. Salaries offered will be commensurate with the qualifications and experience of the candidates. Applications, which will be treated in confidence, should be addressed to The Manager, Development and Research Department, The Mond Nickel Company, Ltd., Thames House, Millbank, London, S.W.1. Mark envelope "Confidential L.31".

METALLOGRAPHER required for the metallurgical laboratory of Joseph Lucas (Gas Turbine Equipment), Liverpool. A minimum qualification of H.N.C. (metallurgy) is required, and preference will be given to a candidate with experience of the metallography and heat-treatment of aircraft materials. Apply to Personnel Manager, Joseph Lucas (G.T.E.), Ltd., Victor Works, Liverpool 14.

METALLURGICAL ASSISTANT required for investigational and research work in connection with wrought copper and aluminium processes. A knowledge of ferrous metallurgy desirable but not essential. H.N.C. in Metallurgy, L.I.M., or Degree. Laboratory or works experience essential. Pension Scheme, five-day week, and all welfare facilities. Details to: Personnel Manager, The Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, S.E.10.

D. NAPIER & SON, LTD., ACTON

RESEARCH ENGINEER—LUBRICATION & WEAR

A senior research engineer is needed by D. Napier & Son for work on plain journal bearings. He should be of at least university degree standard, and must have a thorough knowledge of the theory of friction and lubrication, with experience in its application to plain journal bearing research and development.

This is likely to be a post of considerable responsibility and offering wide opportunities to the right man.

Please apply, giving full details of age, qualifications, and experience, to Dept. C.P.S., 336/7, Strand, W.C.2, quoting Ref. 795.

OLD-ESTABLISHED NON-FERROUS METALS MANUFACTURERS in S.W. Lancashire require qualified Metallurgists for Process Control.

These vacancies are particularly suitable for young men who have completed, or are about to complete, their National Service.

Applicants should write stating details of education and qualifications to Box No. 409, Institute of Metals, 17 Belgrave Square, London, S.W.1.

TECHNICAL MANAGER required for American subsidiary of British company specializing in the development and manufacturing of chemical and allied products used in the foundry industry. Must have Hons. degree in chemistry with good knowledge of metallurgy or vice versa. Duties include control of chemical and metallurgical laboratories for service work for foundries and for works control and initiating and supervising development work on new products. Must take up permanent residence in the U.S.A. (state of Ohio) after trial period. Excellent dollar salary and good prospects of advancement to high executive position for a man with qualifications and suitable experience. Box No. 411, The Institute of Metals, 17 Belgrave Square, London, S.W.1.

UNIVERSITY OF DURHAM

KING'S COLLEGE, NEWCASTLE-UPON-TYNE

The Prestressed Concrete Development Group offer a research grant of £300, for two years in the first instance, to a graduate in Metallurgy or Chemistry wishing to investigate the chemical and metallurgical conditions affecting high-tensile steel wire in prestressed concrete. The work will take place in the Department of Metallurgy at King's College and could lead to a higher degree. Applications to the undersigned as soon as possible.

G. R. HANSON.
Registrar of King's College.

APPOINTMENT REQUIRED

METALLURGIST, B.Sc. (Hon.), A.I.M., requires post: 10 years' experience, mainly on development work, but has (successfully) performed administrative duties; recently working on vacuum techniques; full testimonials; London area preferred but not essential. Starting salary £1000-£1200, but future prospects of prime importance. Box No. 412, The Institute of Metals, 17 Belgrave Square, London, S.W.1.